Engineering a stem cell house into a home.

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Public Summary:
Stem cells, in contrast to progenitor cells, harbor the unique ability to divide and generate additional stem cells (self-renew) and to produce progeny that differentiate into tissue-specific cells with defined physiological functions. These properties make embryonic stem (ES) cells, induced pluripotent stem (iPS) cells and tissue-specific adult stem cells (aSCs) well suited for regenerative medicine applications. Nevertheless, the clinical use of ES cells, iPS cells, and aSCs for cell-based therapies is hindered by a number of critical hurdles. This paper discusses the solution for one of those hurdles - the creation of an engineered stem cell microenvironment or niche that allows scientists to determine how the cell environment affects the properties of the cell, providing tools for the physician-scientist to regulate stem cell behavior in patients for cell-based therapies.

Scientific Abstract:
In the body, tissue homeostasis is established and maintained by resident tissue-specific adult stem cells (aSCs). Through preservation of bidirectional communications with the surrounding niche and integration of biophysical and biochemical cues, aSCs actively direct the regeneration of aged, injured and diseased tissues. Currently, the ability to guide the behavior and fate of aSCs in the body or in culture after prospective isolation is hindered by our poor comprehension of niche composition and the regulation it imposes. Two-and three-dimensional biomaterials approaches permit systematic analysis of putative niche elements as well as screening approaches to identify novel regulatory mechanisms governing stem cell fate. The marriage of stem cell biology with creative bioengineering technology has the potential to expand our basic understanding of stem cell regulation imposed by the niche and to develop novel regenerative medicine applications.